CH12285-1
- RETURN TO -
INSTRUMENT CONTROL
SYLVANIA SES -- West

INSTRUCTION MANUAL

MODEL PFA 23A
PEN FUNCTION
AMPLIFIER

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When ordering parts from Scientific-Atlanta, Inc., be sure to include the equipment model number, equipment serial number, and a description of the part.

MODEL NO. _____

SERIAL NO. _____

ID No. CA-12285-1
– RETURN TO –
INSTRUMENT CONTROL
SYLVANIA SES -- West

INSTRUCTION MANUAL

MODEL PFA 23A
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CHANGE NOTICE #1

INSTRUCTION MANUAL

MODEL PFA 21A, Fourth Edition, March 1963
MODEL PFA 22A, Fifth Edition, March 1963
MODEL PFA 23A, Fifth Edition, March 1963
MODEL PFA 24A, Fourth Edition, March 1963
MODEL PFA 25A, Fifth Edition, March 1963

The following component has been changed since publication of the manual

Component	Was	Changed To
R33-2	8200 ohms ±10% 1/2 watt	Value determined at factory

MODEL PFA 23A

PEN FUNCTION AMPLIFIER

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SECTION 1

GENERAL DESCRIPTION

1.1 Introduction

The Model PFA 23A Pen Function Amplifier is a miniature plug-in unit designed for use with Scientific-Atlanta Series APR 30 Polar Antenna Pattern Recorders and Series APR 20 Rectangular Antenna Pattern Recorders. This unit together with the proper pattern recorder plug-in potentiometer determines the pattern recorder pen function. The Model PFA 23A Pen Function Amplifier permits the selection of a linear or a logarithmic pattern recorder pen function. The Model P-3A logarithmic plug-in potentiometer must be used with the pattern recorder to obtain a logarithmic pen response and the Model P-1A linear potentiometer must be used with the pattern recorder to obtain a linear response.

The pen function amplifier accepts an amplitude modulated audio carrier at a frequency between 400 and 2500 cps. This signal is normally supplied by either a crystal-bolometer amplifier or a dc-chopper preamplifier.

A signal level meter, located on the front panel of the pen function amplifier, provides monitoring of the signal at the amplifier input over an 80-db dynamic range. The meter has a 40-db scale and is logarithmically calibrated to correspond to both a linear recorder input and a square-law recorder input. A step attenuator and a variable attenuator provide the additional dynamic range.

1.2 Specifications

Pen Functions	Logarithmic Linear
Input Impedance	
Linear	10,500 ohms
Logarithmic	2200 ohms
Signal Level Meter Calibration	
Referred to linear input	0 to 40 db
Referred to square-law input	0 to 20 db

Signal Level Meter Calibration Accuracy	
40-db range	±1.5 db between 0 and 30 db
20-db range	±0.75 db between 0 and 15 db
Signal Level Meter Attenuation*	
Fixed	20 db
Variable	20 db
Zero-Set Range (Linear Only)	±5% of full scale

*Attenuation referred to square-law input.

SECTION 2

OPERATION

2.1 Logarithmic Pen Function

To provide a logarithmic pattern recorder pen response, insert the Model P-3A logarithmic potentiometer in the proper position in the recorder head and turn the PEN FUNCTION switch located on the front panel of the pen function amplifier to the LOGARITHMIC position. The pattern recorder is now properly connected to provide a logarithmic pen response.

The ZERO SET circuit is not used during logarithmic recorder operation since the recorder pen will normally seek a null position below the lower excursion of the chart scale when zero signal input is applied to the recorder.

The DAMPING CORRECTION adjustment provides a means of equalizing the upscale and downscale recorder pen damping when a nonlinear pen function is used.

Adjustment of the DAMPING CORRECTION control when using a logarithmic recorder pen response is accomplished as follows:

(a) Apply sufficient signal to the input of the preamplifier of the recorder to provide greater than half-scale pattern recorder pen deflection.

(b) Turn the DAMPING CORRECTION control fully counterclockwise.

(c) Operate the step attenuator on the preamplifier to introduce both an upscale and downscale pen step.

(d) Reduce the amount of pen servo amplifier TACHOMETER control to obtain overshoot of the recording pen at the end of both the upscale and the downscale pen steps. This overshoot will be much larger at the end of the upscale step.

(e) Set the DAMPING CORRECTION adjustment for equal overshoot at the ends of both the upscale and downscale pen steps.

(f) Reset the pen servo amplifier TACHOMETER control for minimum overshoot and undershoot at the ends of the upscale and downscale pen steps.

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2.2 Linear Pen Function

To provide a linear pattern recorder pen response, insert the Model P-1A linear potentiometer or the Model P-2A linear-square-root potentiometer in the proper position in the recorder head. Turn the PEN FUNCTION switch, located on the front panel of the pen function amplifier, to the LINEAR position. The pattern recorder is now properly connected to provide a linear pen response.

The DAMPING CORRECTION circuit is not used during operation of the recorder with the linear pen response and no adjustment is necessary.

The ZERO SET adjustment should be adjusted to obtain zero pen deflection with zero input signal to the preamplifier or with the preamplifier ATTENUATOR set to the OFF position.

2.3 Signal Level Meter

The logarithmically calibrated meter and associated attenuators located on the front panel of the pen function amplifier provide monitoring of the signal appearing at the amplifier input. The 40-db dynamic range of the meter together with a 40-db fixed attenuation step and 40 db of variable attenuation provide metering of the signal over the full dynamic range of signal level which may be recorded. This meter is useful to provide signal level indication when initially adjusting the signal-source modulation frequency, for setting the received power level, and to aid in locating the main lobe of the antenna pattern. In addition, the meter may be used for VSWR measurements.

The meter is provided with two logarithmic scales: The black scale is calibrated to indicate relative signal strength when using a linear detector; the red scale is calibrated to indicate signal strength when using a square-law detector.

2.4 Full-Scale Adjustment

The FULL SCALE ADJUST potentiometer (R22-2), accessible at the rear of the pen function amplifier chassis, provides adjustment of the overall gain of the amplifier. This adjustment is initially set to provide the specified full-scale sensitivity of the overall pattern recorder. This adjustment should be reset as the tubes age to maintain the proper full-scale sensitivity.

SECTION 3

DETAILED DESCRIPTION

3.1 Input Circuit

A schematic diagram of the Model PFA 23A Pen Function Amplifier is located at the rear of this manual.

The input signal to the pen function amplifier is coupled through either P1-2, pin C or P1-2, pin D. Pin D furnishes a high-level signal from the 600-ohm winding of the output transformer of the plug-in preamplifier and pin C furnishes a low-level signal from the 50-ohm winding of the output transformer of the plug-in preamplifier.

The PEN FUNCTION switch (S2-2) selects the appropriate input for either the logarithmic or the linear pen response. In addition, S2-2 properly connects the appropriate pen function potentiometer, which is coupled to the amplifier through J2-2, and selects the output circuit which is coupled to the pen servo amplifier. A block diagram of the basic circuit for each pen response is shown in the Series APR 20 and Series APR 30 Recorder instruction manuals.

The high-level signal from the preamplifier appearing at pin D of P1-2 is coupled to the METER ATTENUATOR switch (S1-2). This switch either couples the signal directly to the METER GAIN potentiometer (R4-2) or to the 20-db fixed attenuator consisting of R1-2, R2-2, R3-2, R4-2 and R6-2. The wiper of the METER GAIN potentiometer is coupled through R5-2 to the grid of the first half of V1-2. The fixed and variable attenuators are designed to provide a constant load of approximately 100 k ohms to the applied signal. Resistor R5-2 isolates the grid of the first half of V1-2 from the input line to prevent loading if the applied signal level is sufficient to cause grid current to flow.

The impedance provided by the signal-level meter attenuator network and amplifier must remain constant to prevent a change in the loading of the input signal which determines the position of the recording pen.

Tube V1-2 is a two-stage, fixed-gain, resistance-coupled amplifier which drives the SIGNAL LEVEL meter through meter rectifiers CR1-2 and CR2-2. The METER CALIBRATION potentiometer (R14-2) is provided to permit calibration of the

meter using an external attenuator. The adjustment screw of R14-2 is located on the terminal board at the top-inside of the amplifier, behind the meter.

When S2-2 is in the LOGARITHMIC position, the high-level input signal is connected through J2-2 to the logarithmic potentiometer. The signal from the center arm of the logarithmic potentiometer is connected to the grid of the first half of V2-2. The signal applied to the grid is logarithmically attenuated proportional to the shaft position of the logarithmic potentiometer. When in the LINEAR position of the PEN FUNCTION switch, the low-level preamplifier output appearing at pin C of P1-2 is attenuated by resistive network R16-2 and R17-2 and directly coupled to the grid (pin 2) of V2-2.

3.2 Intermediate Stages

The first and second halves of V2-2 are resistance-coupled amplifiers providing a total voltage gain of 41 db. The FULL SCALE ADJUST potentiometer, located in the grid circuit of the second half of V2-2, provides approximately 6 db of gain adjustment. This permits initial adjustment of the recorder full-scale sensitivity and periodic readjustment as required. Tube V3-2 is a resistance-coupled amplifier and a transformer-coupled amplifier employing degenerative feedback to obtain good linearity with an output signal level in excess of 100 volts peak. The overall gain of these two stages is 50 db. The high-level output of T1-2 is applied to the rectifier and filter combination consisting of CR5-2, R43-2, C11-2, R42-2, and C12-2. Because of the high level of the applied signal, a detector linearity to better than 1% of full output is obtained. The RC filtering provided is sufficient to eliminate carrier frequencies between 400 cps and 2500 cps, yet permits adequate low-frequency response to obtain a recorder pen speed of 40 inches per second.

3.3 Output Circuit

Two sections of PEN FUNCTION switch S2-2 are used to select the pen function amplifier output corresponding to the selected pen function.

When in the LOGARITHMIC position of the PEN FUNCTION switch, the negative dc output of half-wave rectifier CR5-2 is summed with a positive reference signal and the difference voltage is coupled to the pen servo amplifier through pin A of P1-2. Since balancing is obtained by positioning the logarithmic potentiometer

which precedes the amplifier, the level of the voltage at the output of CR5-2 is constant (-34 volts) when the system is nulled. Diode CR6-2, in series with the potentiometer R48-2, provides a means of equalizing the slopes of the positive and the negative error signals which are unequal because of the logarithmic pen response. For a rectified signal greater than the reference voltage, the error signal is negative; thus diode CR6-2 conducts placing R48-2 in parallel with the series combination of R41-2 and R40-2. For a resultant positive error signal, diode CR6-2 is an open circuit removing R48-2 from the circuit. With this arrangement, DAMPING CORRECTION potentiometer R48-2 can be adjusted to equalize the slopes of the positive and negative error signals.

When the PEN FUNCTION switch is in the LINEAR position, the negative output voltage of half-wave rectifier CR5-2 is summed with a positive reference voltage which is linearly proportional to the recorder pen position. This reference voltage is made to exactly balance the rectifier output of -65 volts at full-scale pen deflection and zero volts at zero-scale pen deflection.

The ZERO SET potentiometer (R52-2) provides a means of introducing a small positive or negative potential to the linear signal-reference summing network to permit adjustment of the pen position to scale zero with zero input signal.

3.4 Heater and Plate Power

Heater and plate voltages are furnished to the pen function amplifier through P1-2. The tube heaters are fed by a -12 volt supply; a total heater current of 0.45 ampere is required. A negative voltage for one end of the ZERO SET potentiometer is obtained from the heater supply. Resistive divider R36-2 and R37-2 and Zener diode CR4-2 provide regulation of this negative potential.

The +150-volt potential is used as the source of reference potential and as the positive potential for the ZERO SET potentiometer.

The +250-volt potential is applied to the plate circuits of all amplifiers. This voltage is obtained from the +250 volt regulated supply which furnishes plate potential throughout the pattern recorders.

SECTION 4

MAINTENANCE

4.1 General

In the event of faulty operation of any part of the pen function amplifier, a visual inspection of tubes, cable connections, and other components should be completed first. Afterward, standard maintenance procedures should be followed to isolate the trouble to a particular stage and then to the defective component. To aid in the maintenance, the following voltage and gain tables provide a means of testing the static and dynamic circuit operation.

4.2 Static Measurements

Table 4.1 provides typical values of dc voltages present at the tube pins of the amplifier stages. These voltages were measured with respect to ground using a 20,000 ohms-per-volt voltmeter and are subject to standard tolerances of ±10%. During measurement the pattern recorder pen motor ON-OFF switch and the preamplifier ATTENUATOR should each be in the OFF position.

TUBE	PIN NUMBER								
	1	2	3	4	5	6	7	8	9
V1-2	+112	0	+1.0	0	-12	+175	0	+0.83	-6
V2-2	+62	0	+1.2	0	-12	+85	0	+1.8	-6
V3-2	+226	0	+7.0	0	-12	+97	0	+4.0	-6

Table 4.1, DC Voltages

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4.3 Dynamic Measurements

Table 4.2 provides typical values of voltage-gain per stage for the pen function amplifier. These measurements were made with a 1000-cps signal applied first to pin 2 of V1-2 and then to pin 2 of V2-2.

Gain Measured		Voltage Gain (db)
From	To	
Pin 2, V1-2	Pin 7, V1-2	34
Pin 7, V1-2	Pin 6, V1-2	20
Pin 2, V2-2	Pin 1, V2-2	26
Pin 7, V2-2	Pin 7, V3-2	15
Pin 7, V3-2	Pin 2, V3-2	22
Pin 2, V3-2	Pin 1, V3-2	22
Pin 1, V3-2	Terminal 5, T1-2	6

Table 4.2, Gain Measurements

SECTION 5

PARTS LIST

MANUFACTURERS' CODE LETTERS

Corrections may have been made to this manual by hand and/or an Instruction Manual Change Notice sheet may be inserted immediately following the frontispiece to reflect any changes to the equipment made after the printing of the manual.

Certain parts in this equipment may be interchangeable with equivalent components of other manufacturers.

When ordering parts from Scientific-Atlanta, be sure to include the following information.

Part Number
Manufacturer
Scientific-Atlanta Model Number
Scientific-Atlanta Serial Number

Code	Manufacturer
A	Aerovox
AB	Allen-Bradley
ABE	Amphenol-Borg
C	Con-Elco (Edcliff Instruments)
CD	Cornell-Dubilier
CH	Cutler-Hammer
CRL	Centralab
GE	General Electric
O	Ohmite (LD = Little Devil)
SA	Scientific-Atlanta
TE	Transitron
TT	Triad

PARTS LIST

MODEL PFA 23A

PEN FUNCTION AMPLIFIER

Component Designation	Description	Mfr.*	Mfr. Part No.
C1A/B/C	Capacitor, fixed, electrolytic, 10-10-10 µf, 300v	A	AFH 3-22
C2 C7 C10	Capacitor, fixed, electrolytic, 25 µf, 25v	A	PWE 25025
C3 C12	Capacitor, fixed, Mylar, 0.01 µf, 400v	CD	WMF4S1E
C4	Capacitor, fixed, Mylar, 0.047 µf, 400v	CD	WMF4S47E
C5 C6 C9	Capacitor, fixed, Mylar, 0.0047 µf, 400v	CD	WMF4D47E
C7	See C2		
C8	Capacitor, fixed, ceramic, 470 µµf, 1000v	A	BC
C9	See C6		
C10	See C2		
C11	Capacitor, fixed, Mylar, 0.022 µf, 300v	CD	WMF4S22E
C12	See C3		
CR1 CR2 CR6	Diode, germanium	TE	1N277
CR3	Diode, "Stabistor," 6 piv, 0.64v ±10% @ 1 ma.	TE	SG-22 (1N816)
CR4	Diode, silicon	TE	1N2032
CR5	Diode, silicon	TE	1N3079
CR6	See CR2		
M1	Meter, signal level	SA	APR-EA-0213

*See "MANUFACTURERS' CODE LETTERS."

Component Designation	Description	Mfr.*	Mfr. Part No.
R7 R9 R21 R25 R31 R34	Resistor, fixed, composition, 470,000 ohms ±10%, 1/2w	O	LD
R8	Resistor, fixed, composition, 3900 ohms ±10%, 1/2w	O	LD
R9	See R7		
R10	Resistor, fixed, composition, 680 ohms ±10%, 1/2w	O	LD
R11 R13 R16 R40 R53	Resistor, fixed, composition, 10,000 ohms ±10%, 1/2w	O	LD
R12	Resistor, fixed, composition, 47,000 ohms ±10%, 1/2w	O	LD
R13	See R11		
R14	Resistor, variable, wirewound, 5000 ohms ±10%, 2w	C	0250L-2-5K
R15	Resistor, fixed, composition, 4700 ohms ±10%, 1w	O	LD
R16	See R11		
R17	Resistor, fixed, composition, 470 ohms ±10%, 1/2w	O	LD
R18	Resistor, fixed, composition, 68 ohms ±10%, 1/2w	O	LD
R19	Unassigned		
R20	Resistor, fixed, composition, 3300 ohms ±10%, 1/2w	O	LD
R21	See R7		
R22	Resistor, variable, composition, 250,000 ohms ±10%, 2w	AB	JLU 2541
R23 R26 R43	Resistor, fixed, composition, 270,000 ohms ±10%, 1/2w	O	LD

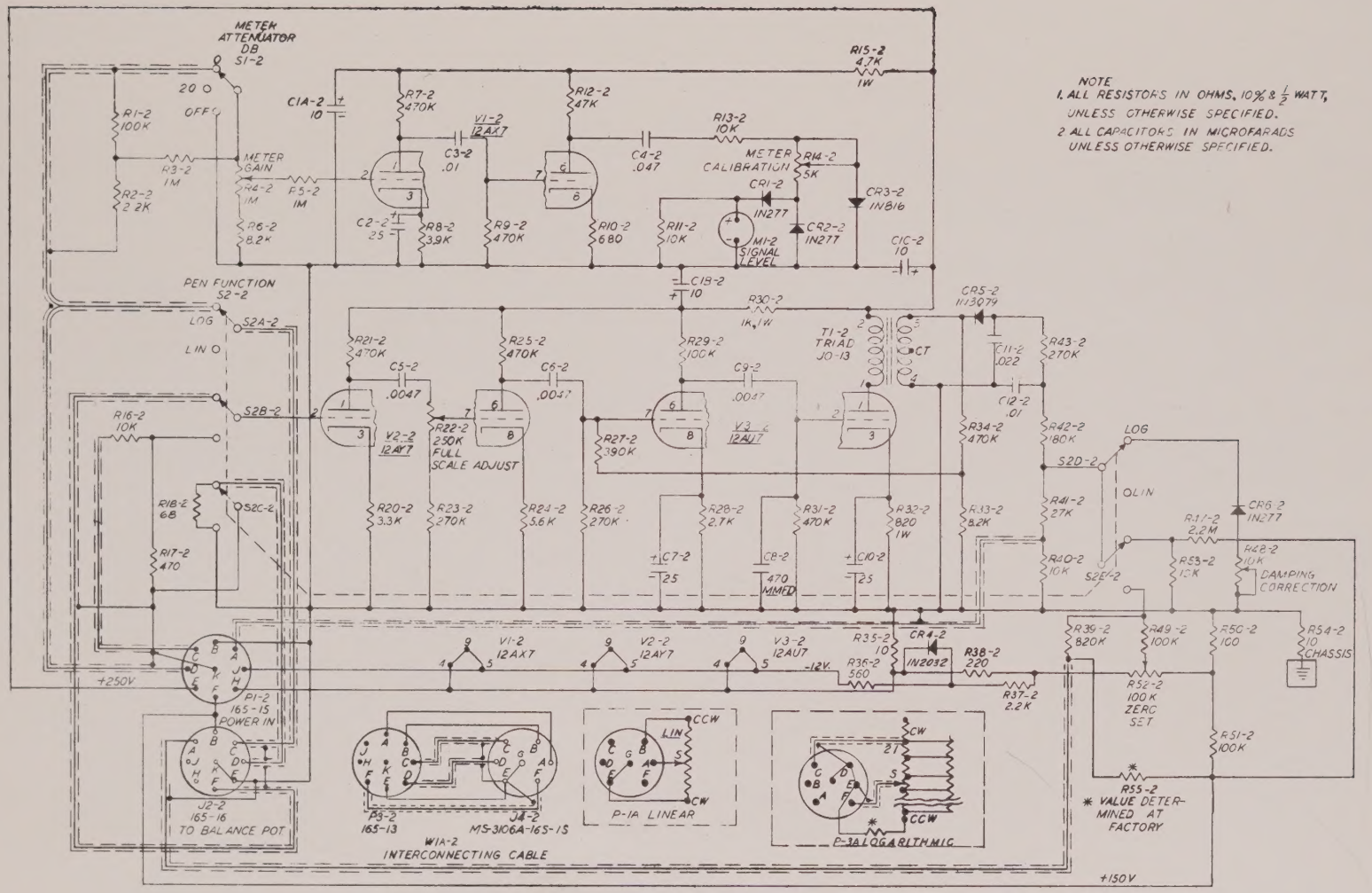
*See "MANUFACTURERS' CODE LETTERS

Component Designation	Description	Mfr.*	Mfr. Part No.
R24	Resistor, fixed, composition, 5600 ohms ±10%, 1/2w	O	LD
R25	See R7		
R26	See R23		
R27	Resistor, fixed, composition, 390,000 ohms ±10%, 1/2w	O	LD
R28	Resistor, fixed, composition, 2700 ohms ±10%, 1/2w	O	LD
R29	See R1		
R30	Resistor, fixed, composition, 1000 ohms ±10%, 1w	O	LD
R31	See R7		
R32	Resistor, fixed, composition, 820 ohms ±10%, 1w	O	LD
R33	Resistor, fixed, composition, 8200 ohms ±10%, 1/2w	O	LD
R34	See R7		
R35 thru R54	Resistor, fixed, composition, 10 ohms ±10%, 1/2w	O	LD
R36	Resistor, fixed, composition, 560 ohms ±10%, 1/2w	O	LD
R37	See R2		
R38	Resistor, fixed, composition, 220 ohms ±10%, 1/2w	O	LD
R39	Resistor, fixed, composition, 820,000 ohms ±10%, 1/2w	O	LD
R40	See R11		
R41	Resistor, fixed, composition, 27,000 ohms ±10%, 1/2w	O	LD
R42	Resistor, fixed, composition, 180,000 ohms ±10%, 1/2w	O	LD
R43	See R23		
R44 thru R46	Unassigned		

*See "MANUFACTURERS' CODE LETTERS."

Component Designation	Description	Mfr.*	Mfr. Part No.
R47	Resistor, fixed, composition, 2.2 megohms ±10%, 1/2w	O	LD
R48	Resistor, variable, composition, 10,000 ohms ±10%, 1/2w	AB	JLU 1031
R49	See R1		
R50	Resistor, fixed, composition, 100 ohms ±10%, 1/2w	O	LD
R51	See R1		
R52	Resistor, variable, composition, 100,000 ohms ±10%, 2w	AB	JLU 1041
R53	See R11		
R54	See R35		
R55	Resistor, fixed, composition, Approx. 560,000 ohms (value determined at factory) ±10%, 1/2w	O	LD
S1	Switch, toggle, bat handle, SPDT, center off	CH	7581-K6
S2	Switch, rotary, 3 positions, 5 circuits, ceramic	CRL	PA 2015
T1	Transformer, interstage	TT	JO13
V1	Tube, electron, 12AX7	GE	12AX7
V2	Tube, electron, 12AY7	GE	12AY7
V3	Tube, electron, 12AU7	GE	12AU7

*See "MANUFACTURERS' CODE LETTERS."



NOTE
1. ALL RESISTORS IN OHMS, 10% & 1/2 WATT, UNLESS OTHERWISE SPECIFIED.
2 ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

PEN FUNCTION AMPLIFIER PFA 23A SCHEMATIC (LIN-LOG)

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